NPS-54-87-001

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CONTRACTING AS A SCIENCE

by

David V. Lamm

and

Steven A. Park

January 1987

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Prepared for: Naval Postgraduate School
Monterey, California 93943

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UNCLASSIFIED

URITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS N/A
SECURITY CLASSIFICATION AUTHORITY N/A	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited
DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
ERFORMING ORGANIZATION REPORT NUMBER(S) NPS-54-87-001	5. MONITORING ORGANIZATION REPORT NUMBER(S)
NAME OF PERFORMING ORGANIZATION Dept. of Admin. Sciences Naval Postgraduate School 6b OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
ADDRESS (City, State, and ZIP Code) Code 54 Monterey, California 93943	7b ADDRESS (City, State, and ZIP Code)
NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
ADDRESS (City, State, and ZIP Code)	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

TITLE (Include Security Classification)

CONTRACTING AS A SCIENCE (UNCLASSIFIED)

PERSONAL AUTHOR(S)
David V. Lamm and Steven A. Park

TYPE OF REPORT Final	13b. TIME COVERED FROM ______ TO ______	14 DATE OF REPORT (Year, Month, Day) January 1987	15 PAGE COUNT 39

SUPPLEMENTARY NOTATION

COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Contracting, Science, Principles, Procurement, Body of Knowledge

ABSTRACT (Continue on reverse if necessary and identify by block number)

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DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
NAME OF RESPONSIBLE INDIVIDUAL David V. Lamm	22b TELEPHONE (Include Area Code) (408) 646-2775 22c. OFFICE SYMBOL

FORM 1473, 84 MAR

83 APR edition may be used until exhausted.
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SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

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This report compares the principal characteristics of contracting against the structure of science which includes four critical criteria: (1) a distinct subject matter, (2) a description and classification of the subject matter, (3) the presumption of underlying uniformities and regularities concerning the subject matter, and (4) the adoption of the scientific method for studying the subject matter. The report concludes that contracting meets, to varying degrees, the four criteria and is, in fact, evolving toward a mature science. The reader should take particular note of the examination of the contracting body of knowledge, proposed contracting taxonomies, contracting principles which were surfaced through interviews, and the manner in which behavioral sciences apply the scientific method. The report also discusses the purpose of a contracting science, the trademarks of science, and the importance of contracting research.

CONTRACTING AS A SCIENCE

by

David V. Lamm
and
Steven A. Park

Introduction

The concept of contracting as a science has been, in recent years, lightly addressed in the literature and has briefly invaded discussions among theorists and practitioners. Much of the research undertaken within the contracting boundaries has been primarily application oriented, designed to solve a particular problem or support a general supposition. Regardless of the rigor introduced into these research efforts, they have gone largely unnoticed by the general contracting community because they fail the test of solid grounding in a theoretical framework characterized by principles and laws.

The idea that contracting is, or could be identified as, a science is viewed by many as a worthless exercise. Those who have given much thought to this notion are widely diverse in their opinion regarding the validity or necessity of distinguishing contracting as a science. Because contracting has been frequently considered as a service or support function accomplished by administrative-type personnel, it is typically held as a non-discipline, unworthy of any serious analysis. Little effort, therefore, has been put forth to identify a methodology of contracting and the body of contracting knowledge.

Although several textbooks and articles have been published setting forth the "Principles" of procurement, purchasing, acquisition or contracting, none have attempted to define a "contracting principle" or to develop a theory of contracting within which its various aspects could be examined. At best, these can only be portrayed as "policies," "functions" or "procedures."

This article is devoted to the proposition that contracting is a science, albeit in infant stages, and the evolution of contracting into a mature science can only occur with the careful identification of its underlying principles integrated into a systematic theory, rigorously tested and constantly challenged. With this base, theorists and practitioners can begin to explore and build the sound theoretical foundation necessary for contracting science activities: data collection, evaluation, analyses and prediction.

Bartels, in addressing the emerging issue of marketing as a science over three decades ago, contends that:

> If marketing is to be regarded as a science, the study of it both in form and content must correspond to the standards of science in the social realm. First, the objective of observation and investigation must be the establishment of general laws or broad principles, not merely settled rules of action or operating procedures. Second, prediction made possible through the development of laws should be of social import and not merely institutional application. Third, theory and hypotheses employed in prediction and in the drawing of further inferences should be useful for the extension of knowledge as well as for guiding administrative means

> toward profitable ends. Fourth, abstractions as well as concrete facts should be used in the explanation of marketing phenomena.[1]

The same might be said of contracting. Without knowing, and perhaps even caring, those involved in the study of contracting phenomena have "violated" each of the four standards offered by Bartels. First, the objective of observation and investigation in the contracting field has not been the establishment of general laws or broad principles and has rarely risen much above settled rules of action or operating procedures. Despite the label of "principle," contracting research has resulted in a pot pourri of management policies and actions. In exploring the environment of Federal contracting researchers, Williams and Arvis lament that:

> Where they would seek rigorous analysis, they find anecdote and opinion; instead of objectivity, advocacy; products based not on empirical study, but on essay and exposition; no integrated accumulating body of knowledge, but isolated collections of works on related topics.[2]

Regarding Bartels' second standard, virtually every issue studied has been pursued for institutional application. This has been a function of sponsorship and funding. The mechanism doesn't exist to develop contracting laws independent of institutional bias, and any predictive capability of research results has not been developed for its social import but primarily for its institutional applicability. Further, one might ask what is even intended by social import. Perhaps the ability to use laws to predict for institutional benefit may be of sufficient social import in and of itself.

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[1] Bartels, Robert, "Can Marketing Be A Science?" The Journal of Marketing, Vol. XV, No. 3, January 1951, p. 323.

[2] Williams, Robert F. and Paul F. Arvis, "The Possibility of A Contracting Science," 1985 Proceedings of the Federal Acquisition Research Symposium, pp. 26-27.

Bartels's third standard is more difficult to assess because the contracting discipline has failed to generate a systematic theory and set of hypotheses, let alone employ them in a predictive capacity. When such a level has been achieved (theory and hypotheses), significant effort will be necessary to recognize how knowledge might be extended over the more compelling requirement to predict for decision-making purposes.

Lastly, the contracting discipline has yet to identify those abstractions relevant to the explanation of contracting phenomena before ensuring they are integrated with concrete facts.

The Nature of Science

Before embarking on an exploration of contracting as a science, it would be useful to first examine the characteristics and criteria of science. Such an examination should reveal the structure within which contracting must necessarily be analyzed, and successfully so, before achieving science status. A brief discussion of the requirements, functions, goals and aspects of science will hopefully lead to a better grasp of the manner in which contracting as a science must be observed and recognized.

Although many definitions of science exist, Campbell may well have best defined science by stating:

> Science is the study of those judgments concerning which universal agreement can be obtained. It is the fact that

> there are things concerning which universal agreement can be obtained which gives rise to our belief in the external world, and it is the judgments which are universally agreed upon which are held to give us information about the world.[3]

This view of science is supported by Ziman through his argument that "the goal of science is to achieve a consensus of rational opinion over the widest possible field."[4]

Campbell speaks of "universal agreement" while Ziman speaks of "consensus of rational opinion." Both of these require that members of the community have an opportunity to evaluate and examine those items to be judged, and further, to set forth agreement/disagreement or an opinion regarding these items. Science, therefore, involves an examination of opinions or propositions with the objective of reaching general consensus (possibly universal agreement) with respect to these opinions or propositions. Science consists of laws and theories which have survived critical testing and study by capable and disinterested individuals and which are found "so persuasive that they are almost universally accepted."[5]

If science is the striving for general consensus of judgments, what are the essential characteristics of a science? Although much debate has occurred on this topic, Hunt has emerged with one of the most widely accepted views of the substantive characteristics differentiating sciences from other disciplines. These include:

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[3] Campbell, Norman, What Is Science?, Dover Publications, Inc., 1952, p. 27.

[4] Ziman, John M., Public Knowledge, University Printing House, 1968, p. 9.

[5] Ibid.

1. A distinct subject matter
2. The description and classification of the subject matter
3. The presumption of underlying uniformities and regularities concerning the subject matter
4. The adoption of the method of science for studying the subject matter[6]

Following a brief discussion of scientific laws, theories and principles, these four essential characteristics will be used to analyze the degree to which contracting meets the definitional demands of science.

Science is structured by the following:

1. Observations (empirical data)
2. Concepts and constructs which are abstractions of phenomenon or other higher level concepts
3. Hypotheses which express possible explanations of cause and effects
4. Principles or laws which consist of hypotheses that have been subjected to some form of experimental verification
5. Theories or derived propositions which relate data, hypotheses and laws in a general and consistent structure[7]

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[6] Hunt, Shelby, Marketing Theory: Conceptual Foundations of Research Marketing, GRID, Inc., 1976, p. 21.

[7] Heuer, Gerald R. J., Major, USAF, Kingston, John C., Captain, USAF, and Williams, Eddie L., Captain, USAF, A Proposed Definition and Taxonomy for Procurement Research in the Department of Defense, unpublished Masters thesis, Air Force Institute of Technology, Wright-Patterson AFB, Dayton, Ohio, September 1977.

One of the key elements of this structure is the idea of laws or principles. Simply stated, a law is an "assertion of an invariable association."[8] Invariable, as used here, implies an unchanging or constant association. Laws are considered the raw material of a science. Not only are complex, sophisticated laws always being built from more elementary and simpler laws, but the elementary, simpler laws are always in the process of being broken down into more basic invariable associations.[9] Thus, scientific laws are in a constant state of examination and development. Laws order experiences; that is they "change miscellaneous collections of apparently unconnected observations into a connected series of particular instances."[10] Laws are needed because they make nature intelligible.

Although the invariable association requirement is the fundamental and primary requirement needed to classify a law, other criteria must also be met. Hunt has stated the following as additional criteria of laws:

1. Generalized conditionals: If/then relationship.
2. Empirical content: Laws must have a basis in factual observations; nonsense statements or strictly analytical statements would not qualify.
3. Nomic Necessity: The implication that the occurrence of some phenomenon _must_ be associated with some other phenomenon; the relationship cannot be just chance (invariable association).

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[8] Campbell, _What Is Science?_, p. 49.

[9] Ibid., pp. 43-45.

[10] Ibid., p.68.

4. Systematically integrated: Laws must not be just a summary statement of observed regularities, but must be able to be assimilated into the larger body of scientific knowledge.[11]

Laws are generally recognized to be of two types: empirical and theoretical. These types are distinguished by the methods through which they are derived.[12]

Empirical laws are generalizations derived from an accumulated mass of evidence. Theoretical laws, on the other hand, are

> . . . essentially interpretations based upon presupposed notions and not upon tangible measurable evidence. . . . rules of inferences upon the basis of which probability and prediction are warranted.[13]

With theoretical laws, although experience and evidence may not always confirm the stated relationship, the law may be found to be plausible if it is well framed. Theoretical laws are identified mostly with the social sciences.[14]

Scientific laws can also be classified into various categories in accordance with such factors as time, universality and range.[15] A distinction must be made between laws and principles. Whereas laws are "invariable associations," principles are considered to be fundamental truths or fundamental assumptions. They are, in essence, higher order laws in that principles are basically laws that are held to be of "extreme central importance or significance to a discipline."[16] In addition, substantial evidence which corroborates the validity and reliability of the principle is available. The hierarchial relationships between principles, laws, law-like generalities, and empirical generalities are illustrated in Figure 1.

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[11] Hunt, Marketing Theory, pp. 64-66.

[12] Bartels, "Can Marketing Be A Science?" pp. 320.

[13] Ibid.

[14] Ibid., p. 321.

[15] Hunt, Marketing Theory, pp. 80-96.

Just as laws are used to describe invariable associations, theories are used in science as a means of describing or explaining laws. To use a formal definition,

> A theory is a systematically related set of statements, including some law-like generalizations, that is empirically testable. The purpose of theory is to increase scientific understanding through a systematized structure capable of both explaining and predicting phenomenon.[17]

Three elements are essential to this definition. First is the concept of "systematically related." The statements used to explain phenomena must be incorporated into the total body of scientific knowledge; isolated statements do not contribute to the expansion of scientific understanding.

Second, theories must be "empirically testable." This is needed to ensure that different investigators with different attitudes, beliefs and techniques are able to conduct tests and make observations concerning the validity of the theories. Again, since the purpose of theories is to expand scientific

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[16] Ibid., p. 76.

[17] Ibid., p. 104.

Figure 1

HIERARCHY OF SCIENCE

The evidence corroborating certain laws is overwhelming, and the laws are held to be of extreme central significance or importance to a discipline are called ----------------------> PRINCIPLES

↑

Law-like generalizations for which there is substantial corroborative empirical support are called ---------------> LAWS

↑

Generalized conditionals that (a) have empirical content, (b) exhibit nomic necessity, and (c) are systematically integrated into a scientific body of knowledge are called -------------------> LAW-LIKE GENERALIZATIONS

↑

Statements that specify a relationship of the basic form "All A are B" or "If X occurs, then Y would be expected to occur" are called ----------------------> GENERALIZED CONDITIONALS

Source: Hunt, Marketing Theory

knowledge, any theory not empirically testable would not be able to serve this purpose.

Finally, theories must explain and predict. By "specifying what variables are related to what other variables and how they are related, theories enable scientists to predict from certain variables to other variables."[18] This predictive quality is considered the greatest value of theories.

From a theory, meeting the definition stated above, three things are possible. These are:

---

[18] Kerlinger, Fred N., Foundations of Behavior Research, 2nd Ed., Holt, Rinehart and Winston, 1973, p. 9.

1. The laws which the theory is devised to explain are deduced from it
2. The theory can explain those laws in a sense of introducing ideas which are more familiar, and
3. The theory can predict new laws which ultimately turn out to be true.[19]

In short, theory provides a logical ordering or pattern of observation that can be used for simplifying decision-making and for predicting the future. Theory is necessary for any science and the sophistication of theories is a measure of the maturity of a science.

The Structure of a Contracting Science

Now that the general characteristics of a science and the four critical requirements of science have been presented, it would be appropriate to examine the extent to which the contracting discipline "fits" these requirements of science.

To review, the four criteria of science are:

1. A distinct subject matter
2. A description and classification of the subject matter
3. The presumption of underlying uniformities and regularities concerning the subject matter
4. The adoption of the scientific method for studying the subject matter

Distinct Subject Matter

Hunt states that one of the prerequisites for a field of study to become a science is for that field to have a "distinct subject matter" which can "serve as a focal point for investigation."[20] The distinct subject matter of contracting might be found in the explanation or definition of the contracting process or, more specifically, the definition of a contract. From a Federal Government point of view, a contract is defined as:

---

[19] Campbell, "What Is Science?", p. 89.

> . . . a mutually binding legal relationship that obligates the seller to furnish the supplies or services (including construction) and the buyer to pay for them. It includes all types of commitments that obligate the government to an expenditure of appropriated funds and that, except as otherwise authorized, are in writing. In addition to bilateral instruments, contracts include (but are not limited to) awards and notices of awards; job orders or task letters issued under Basic Ordering Agreements; letter contracts; orders such as purchase orders, under which the contract becomes effective by written acceptance or performance; and bilateral contract modifications. Contracts do not include grants and cooperative agreements . . . .[21]

A more generalized definition with less specific modifications would be that offered by Arvis: "an agreement between two or more competent parties to perform some legal act for consideration."[22]

One possible candidate for the definition of the distinct subject matter of the contracting field is, "the study of acquiring goods and services in the marketplace by utilizing a contractual device."[23] This definition emphasizes the

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[20] Hunt, Marketing Theory, p. 13.

[21] Federal Acquisition Regulations, U.S. Government Printing Office, 1984, Section 2:101.

[22] Arvis, Paul F., Professor, Florida Institute of Technology, Fort Lee, Virginia, Interview granted 25 August 1986.

[23] Sherman, Stanley N., Professor, The George Washington University, Washington, D.C., Interview granted 27 August 1986.

"acquiring" aspect of contracting; however, it might be appropriate to distinguish between contracting, purchasing and acquisition. Contracting does not appear to be synonymous with either purchasing or acquisition. Lorette defines acquisition as

> . . . the process used by people to manage the integration of all activities required to obtain goods and services to meet a need.
>
> These activities include:
>
> - * defining a need
> - * soliciting and exploring alternative solutions
> - * conducting tests and evaluation
> - * choosing what to obtain
> - * selecting sources
> - * conducting price and cost analysis
> - * advertising, negotiating, awarding, and administering contracts
> - * budgeting and financing the above activities.[24]

Purchasing is a method of accomplishing the acquisition function; contracting can be viewed as a type of purchasing; one that is differentiated by the legal characteristic of the contract. Other types of purchasing, although less frequently employed, such as bartering and auctioning, generally do not possess this contract feature. Certainly, contracting is similar to purchasing in terms of buyer/seller relationships, however, the contract and its legal implications alters such relationships. Those areas of inquiry contributing to a better understanding of buyer/seller relationships and characteristics would be a part of the subject matter of a contracting science. By stating "in the marketplace," Sherman's definition acknowledges external forces, both governmental and nongovernmental, which affect the contracting process.

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[24] Lorette, Richard, "Is it Acquisition? Procurement? Contracting?" Government Executive, July 1979, pp. 38-43.

In a recent attempt to establish boundaries around the body of contracting knowledge, Lamm reported a definition adopted by the National Contract Management Association (NCMA) as follows:

> Professional proficiency in contract management requires broad knowledge and a range of skills in the areas of:
>
> 1. Business management, particularly materials and operations management, industrial marketing, financial management, and related accounting.
>
> 2. The economics of materials and operations management.
>
> 3. Cost and price analysis and negotiation techniques.
>
> 4. Legal and regulatory aspects of procurement and contracting.
>
> 5. Managerial planning, decision making, communication, and control.
>
> 6. Procurement and contracting policy and procedures.
>
> 7. Management information systems, and information and data analysis.[25]

Although this definition serves more as a basis for the knowledge and skill requirements of the profession than as a statement of the underlying, integrated, systematic body of theoretical knowledge, it is a useful starting point.

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[25] Lamm, David V., "The Professional Body of Knowledge," Contract Management, Issue 6, Vol. 25, June 1985, pp. 30-31.

Although there is not a clear consensus as to the definition of contracting or a contract, there does appear to be sufficient agreement on the broad boundaries of the field. The first distinguishing characteristic of science is that it relates to a distinct subject matter. Contracting, to the extent that it can be considered the study of acquiring goods and services in the marketplace through a contractual device, would appear to satisfy this requirement.

Description and Classification of Subject Matter

A classification scheme "is a type of non-theoretical system which sets conditions for the applicability of its categorical terms."[26] The importance of classification schemes is that they order the universe of the subject matter and assist in the development of theories. The contracting literature is replete with various attempts to model the contracting process. Sherman suggests that the procurement process should be viewed as a life cycle model on a continuum focusing on the planning phases before contract award and the administrative actions following award.[27] (See Figure 2). Lamm contends that the contracting process consists of six major phases: (1) acquisition planning, (2) source solicitation, (3) source evaluation and selection, (4) contract negotiation, (5) contract award, and (6) contract

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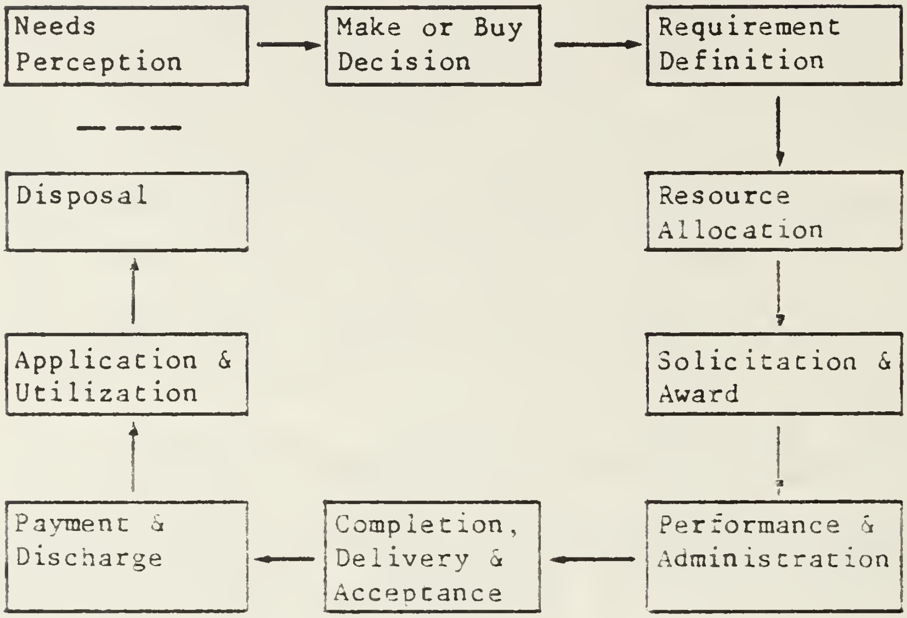
[26] Hunt, Shelby, "The Morphology of Theory and the General Theory of Marketing," Journal of Marketing, Vol. 35, April 1971, p. 66.

[27] Sherman, Stanley N., Government Procurement Management, Wordcrafters Publications, 1985, pp. 220-223.



GENERIC PROCUREMENT MODEL
(Material or Services Acquisition)

Figure 2

administration.[28] This generalized model of the contracting process is somewhat consistent with the model established by the Commission on Government Procurement (COGP) which appears as Figure 3. Judson suggests a "profile of the characteristics of ordinary consumer goods compared to the characteristics of unique products involving some technical uncertainty."[29]

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[28] Lamm, David V., Adjunct Professor, course lecture notes, Principles of Acquisition and Contracting, Naval Postgraduate School, Monterey, CA.

[29] Judson, Robert R., "A Profile of Acquisition Environments," Contract Management, Issue 12, Vol. 26, December 1986, pp. 14-15.

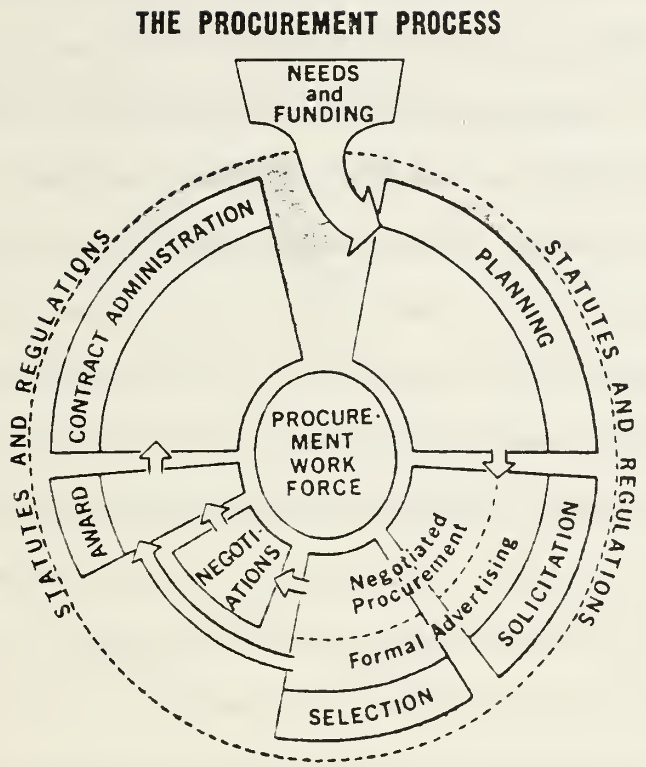
THE PROCUREMENT PROCESS

Figure 3

Perhaps the most definite attempt to develop a contracting classification scheme is that made by Heuer, Kingston and Williams in their thesis "A Proposed Definition and Taxonomy for Procurement Research in the Department of Defense."[30] The proposed taxonomy, although labeled a "procurement taxonomy," might well serve as the basis for a contracting science classification scheme. This particular classification method is a process-oriented taxonomy in that it defines distinct categories along a sequential time line. Although this is an acceptable method of classifying the subject matter of contracting, it might not be the only or the best classification. Additional schemes, more useful for developing theories and for providing an understanding of the subject matter, will probably be needed. These schemes might be focused on the types of goods or services (standard vs. unique), the types of sellers, the hierarchy of relationships required by the contracting process, or an array of contracting functions categorized by knowledge and skill levels. Although additional research is required in this area, preliminary work indicates that contracting can be classified and described in some manner or form.

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[30] Heuer, et al., "A Proposed Definition and Taxonomy for Procurement Research in the Department of Defense."

Underlying Uniformities and Regularities

Of the four criteria for a science, perhaps the most critical is the identification and enumeration of underlying uniformities and regularities. This is based on the assumption that any contracting knowledge must, to be accepted, be based in part on underlying uniformities and regularities of the contracting field. Accordingly, the bulk of the research effort for this article was directed towards the identification and articulation of those principles that were generally accepted by the contracting community. From an expression of these principles, it was felt, the uniformities and regularities which serve as their foundation could be attempted. A principle, as used herein, is a general proposition sufficient to the series of phenomena under consideration to provide a guide for thought. A principle serves as a fundamental truth, a comprehensive law or doctrine from which others are derived or upon which others are founded.[31] In order to identify candidate principles, interviews were conducted with individuals knowledgeable and familiar with the contracting field. The purpose of the interviews was to surface those concepts which might be considered contracting principles. The premise for this particular approach was that if contracting principles do exist, then most, if not all, of the interviewees would be aware of these basic concepts and would express them in some fashion during the interviews. Once the concepts or contracting principles were expressed and categorized, the criteria upon which principles and laws are evaluated and judged were applied. Table 1 is a list of the "principles" offered by interviewees as the best representation of an underlying concept or theory of contracting. Perhaps one of the most notable observations is that there was not overwhelming agreement regarding the existence of any one "principle." (The highest agreement consisted of 55% of the interviewees and then for only one of twelve distinguishable "principles")

As can be observed by the percentage of interviewees citing each concept, all of those presented fell far short of general consensus and only one was offered by more than 50% of the interviewees. This is not to mean that none of the concepts which surfaced in this study are potential candidates as "principles." If the researchers had developed candidate generalizations and then asked the interviewees the degree to which they agreed or disagreed with these propositions, an entirely different pattern of responses could have (and is expected to have) occurred. The idea behind this study was to observe what would surface as general contracting propositions or concepts without prompting.

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[31] Hunt, Marketing Theory, p. 76.

It is appropriate at this point to attempt to determine whether any of the propositions presented in Table 1 might satisfy the conditions of an underlying uniformity or regularity. It is suggested that if one or more of these (or any other propositions which might be offered) can meet the test of underlying uniformities and regularities, they might begin to climb the ladder depicted in Figure 1. To review, relationships which can be (1) expressed as generalized conditionals, which (2) have empirical content, and (3) exhibit nomic necessity, and (4) which are (or can be) systematically integrated into a theoretical body of knowledge could be viewed as law-like generalizations or laws or principles.

To demonstrate how this scheme might apply, item 2 from Table 1 is selected as a candidate for an underlying uniformity or regularity. This proposition was stated essentially in the following fashion by the interviewees: Different environments affect contracts in a different fashion and can affect the effectiveness and process of a contract. As a generalized conditional, this proposition might be stated as follows: "If the environment and assumptions upon which a contract is

TABLE 1

CONCEPTS OF CONTRACTING PRINCIPLES

	CONCEPT	PER CENT OF INTERVIEWEES OFFERING CONCEPT
1.	The principal objective of negotiations is to reach a fair agreement	55
2.	Different environments affect contracts in a different fashion and can affect the effectiveness and process of a contract	36
3.	Price is a function of unique goods vs. standard goods and is determined by the marketplace, demand, cost and negotiating effort	36
4.	In the absence of competition, less effective procurements will probably occur	27
5.	The parties to a contract are motivated by different factors; each party acts to satisfy one's own objectives	27
6.	The buyer has the broadest range of choices to meet system needs	18
7.	Contracting is a sequential time-phased process with multiple paths; the nature of the products determines the path	18
8.	The parties to a contract intend to fulfill the agreement	18
9.	Changes to a contract are evolutionary and in harmony with the peculiarities of the time period and society in general	18
10.	A contract is for the acquisition of goods and services in the marketplace (economic exchange)	9
11.	Each party has a right not to enter into an agreement	9
12.	Contract types are irrelevant to contract performance	9

negotiated and performed are varied, then the process and effectiveness of the contract will be altered." This generalized conditional implies that the occurrence of some phenomena (change in contract process and effectiveness) is associated with some other phenomena (variance in environment/assumptions regarding contract negotiation/performance). In a slightly more developed form, the generalized conditional could be restated "for any X (contract), if X is A (negotiated/performed in differing environments), then X is B (changed in its effectiveness/ process). Moving to the issue of empirical content, Hunt states that "the empirical content criterion rules out both nonsense statements and strictly analytical statements."[32] A nonsense statement (e.g., widgets are always priced low) is easily understood, however, an analytical statement bears additional explanation. An example of the latter would be that "f is either h or it is not h" and any descriptive terms could be used as f and h. Because lawlike statements should say something about the real world and be empirically testable, strictly analytical statements do not qualify as lawlike.[33] Examining the proposition selected and stated as a generalized conditional, it appears to meet the criterion of empirical content. It is not strictly analytical and through empirical study, the relationship can be proven or disproven. Kennedy and others have already performed research in this area and have drawn several conclusions pertaining to the affect of environmental factors upon contract effectiveness.[34] As for the last criterion (systematically integrated into a body of knowledge), the stated generalization has a niche in contracting thought and thinking; it is not an isolated assertion having no theoretical ramifications.

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[32] Ibid., p. 68.

[33] Ibid.

Adoption of the Scientific Method

Perhaps more than any other criterion, application of the scientific method to the study of a specific discipline, is often identified as the boundary line between what is and what is not a science.[35] The scientific method is an ". . . investigation of nature by means of observation, induction, hypothesis, experiment, calculation, prediction and control."[36] Although the scientific method has procedures or techniques generally recognized and accepted by the scientific community, these procedures may and will vary from one discipline to another. These differences in the application of the scientific method are

> . . . imposed by unique characteristics of the field under study--not by a difference in the scientific method. . . . These differences in application are not

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[34] Kennedy, John J., "A Theory on Defense Principles and Practices in Defense Marketing," in Managerial Marketing Perspectives and Viewpoints, 3rd Ed., edited by Eugene J. Kelly and William Lazar, Richard D. Irwin, Inc., 1967, pp. 212-213.

[35] Anderson, Paul F.,"Marketing, Scientific Progress, and Scientific Methods," Journal of Marketing, Vol. 47, No. 4, Fall 1983, p. 18.

[36] Heuer, et al., "A Proposed Definition and Taxonomy for Procurement Research in the Department of Defense," p. 45.

> necessitated by nature, but rather the differences are the result of human limitations in applying the scientific method.[37]

Ziman supports this concept of human limitations in the application of scientific methods, particularly in the social sciences: ". . . the idea of consensus is there, but the intellectual techniques by which it might be created and enlarged seem elusive."[38]

Given the rather "soft" nature of the subject matter of contracting, in terms of human behavior and motivation, it may appear that the subject matter is too elusive to permit rigorous examination and analysis. This is not necessarily the case. The ultimate goal of the scientific method is that the research product be accepted by the professional community. This is accomplished by having research results freely published, reviewed and criticized by the community of contracting professionals. The scientific method is a means of obtaining valid research for the discovery of laws and principles, however, the use of such methods does not itself evolve a science[39]. The scientific method is an acknowledged procedure, however, this procedure is a relative concept; having different meaning and applicability to different disciplines. Anderson states that ". . . it is more important to ask what methodologies will convince the community of a particular research product, than to ask what is the correct method."[40] Each discipline must acknowledge the method that will be used for research validation and act accordingly.

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[37] Ibid., p.46.

[38] Ziman, Public Knowledge, p.28.

[39] Bartels, "Can Marketing Be A Science?" P. 325.

Although levels of rigor for accepting contracting research results may not be high initially, the levels will increase as more contracting professionals become more concerned regarding the credibility and reputation of the discipline. The adoption of higher levels of rigor will force the use of more stringent and reliable methods of testing. In the final analysis, those initiating a new idea, concept or theory should not be concerned with determining the correct scientific method, but rather should seek out the method which will convince the professional community of the validity and soundness of the particular idea, concept or theory.[41]

Obviously, research conducted in a rigorous, well-structured fashion will more likely achieve consensus than that conducted in a haphazard, undisciplined manner. The task for the researcher is to design and follow an approach which is best able to obtain the general consensus necessary for the product to be considered credible and reliable. Regardless of the exact method followed in proving or disproving hypotheses and in conducting research, the vitality of the scientific process lies in the three areas of speculative thinking, deductive reasoning and empirical observation.[42] The degree of rigor involved in these cognitive processes, particularly the last two, will determine the degree of acceptance accorded the results. To the extent that contracting researchers can perform the research process outlined above, and to the extent that general consensus can be reached regarding well-designed and rigorously conducted research, the criterion of science concerning application of the scientific method to the contracting field will appear to have been met.

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[40] Anderson, "Marketing, Scientific Progress, and Scientific Methods," p. 25.

[41] Ibid.

Two other observations regarding the potential for the contracting field to become a science are offered. First, the Hood-Strayer Model concerning sequential research needs in procurement suggests six stages through which research transitions in the evolution of a discipline.[43] These include: (1) Definition of the field - involving descriptive and demographic studies; (2) Differentiation of the field - involving comparative and exploratory studies, need analysis; (3) Standard setting - involving normative-descriptive studies and evaluative research; (4) Technological refinement - involving experimental research and theory building; (5) Respectability and dynamics of the field - involving historical, biographical, field-evaluative, survey-descriptive and comparative studies; and (6) Understanding the dynamics of the field - involving institutional, environmental, force-field and prediction studies. Hood and Strayer contend that procurement (contracting) may be entering Stage 6 of their model, however, the authors of this article contend that contracting may only be making entry into stage 4 which is characterized by hypothesis testing, empirical analysis and theory building.

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[42] Taylor, Weldon J., "Is Marketing a Science? Revisited," Journal of Marketing, Vol. 29, July 1965, p. 52.

[43] Hood, Joseph L. and Daniel E. Strayer, "Sequential Research Needs in the Evolving Discipline of Procurement," paper presented to Sixth Annual DOD Procurement Research Symposium, U.S. Military Academy, West Point, New York, June 1977.

The second piece of evidence supporting the evolution of a contracting science lies in the application of Kuhn's Paradigm Model. According to Kuhn, a science progresses through phases that are directly related to the attainment of more sophisticated and cohesive theories and ideas which have resulted from scientific inquiry and discovery.[44] Kuhn's phases include: (1) Age of Philosophy - characterized by vague, abstract or speculative knowledge where the subject matter appears too complex or intangible to permit genuine experimentation and research; (2) Period of Discovery - characterized by new developments, observations and discoveries which shed some light on the subject matter causing the vague, abstract generalizations to give way to many more contradictory and speculative theories; (3) Epoch of Breakthrough - characterized by a general pattern of explanation where a set of theories becomes more refined and more capable of explaining the phenomenon of the subject matter, thus gaining acceptance by a greater number of people in the field, and (4) Classical Phase -characterized by a refinement of the paradigm, the hardening of theory into orthodoxy, and a restructuring of the paradigm through normal science investigation which causes anomalies to be discovered, thus triggering a "scientific revolution".[45] A review of the contracting discipline over the last several years would indicate that contracting is probably involved in the "Period of Discovery." Better methods of measuring and observing contract performance, contractor motivation and buying strategies have led to the development and expression of more and more theories capable of explaining and predicting some of the phenomena, but not all of it. Theories of pricing, negotiating and competition, to name a few, have been proposed. Gradually, as research techniques advance, more sophisticated and abstract theories will be proposed which have greater explanatory and predictive power and which gain greater acceptance. In this respect, it is not inconceivable that a paradigm may eventually be articulated within the contracting field. Because this paradigm formulation and acceptance is the best indication that a discipline is a science, it seems plausible that contracting will evolve into a science.

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[44] Kuhn, Thomas S., The Structure of Scientific Revolution, 2nd Ed., University of Chicago Press, 1970, pp. 10-34.

The Purpose of a Contracting Science

To what end is it appropriate to pursue the idea that contracting might be a science? Because there are many arguments and controversies pertaining to the establishment of any science involving "human behavior" factors, it would appear that the values and achievements of "science" status must be great enough to counter the criticism and to warrant the effort involved in the determination process. Through a review of the literature, several achievements and benefits have been identified.

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[45] Ibid., pp. 10-65.

First, science and its characteristics, focus on relationships. Science puts heavy emphasis on obtaining greater precision of relationships among phenomena under stated conditions.[46] Contracting as a process or as a collection of functions or as a progression of events and activities can definitely be characterized as a set of relationships. These would include the buyer-seller relationship, the relationship between certain and uncertain goods, and the relationship between pricing strategies and outcomes, to name but a few. Recording just facts and figures is not good enough; searching for cause and effect relationships is dictated by the science characteristics.

Secondly, science concentrates on the use of abstract concepts. Science attempts to simplify understanding of relationships through the use of abstract concepts which permit generalizations.[47] This abstraction feature is critical for gaining the general consensus necessary for a science. With the proliferation of facts and knowledge resulting from increased research, the ". . . integration of knowledge on higher planes of unification and abstraction . . ." is needed.[48] Science, because it places a high priority on the abstraction of concepts into generalized statements, can be extremely useful in the integration/unification process. The development of abstract conceptual schemes also opens new frontiers in human behavior and suggests additional avenues for observation and experiment.[49]

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[46] Thompson, James D., "On Building an Administrative Science," Administrative Science Quarterly, June 1956, p.104.

[47] Ibid, pp. 104-105.

Third, science supports and even demands the development of operational definitions.

> Science requires that concepts be defined by a series of operations which permit the sensory perception and identification of the phenomena referred to by those concepts. Operational definitions make possible independent repetition of observations by scientists in many places at many different times.[50]

Contracting faces the same definitional problems that plague other disciplines, e.g., no one commonly accepted definition for a term or phase used extensively throughout the field. Through more rigorous development and application of operational definitions, semantic difficulties can be reduced, more precise relationships can be identified and a more exacting application of the scientific method can be attempted.

Fourth, a contracting science will help to focus the efforts of researchers while in turn supporting the credibility of their efforts. William and Arvis contend that:

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[48] Bartels, Robert, "General Theory of Marketing," *Journal of Marketing*, Vol. 32, January 1968, p.29.

[49] Taylor, "Is Marketing a Science? Revisited," p. 57.

[50] Thompson, "On Building an Administrative Science," p. 105.

> Researchers will find more order in their output, and will have confidence in the validity of the accumulated body of knowledge. Academicians will be able to teach not only contracting techniques and policy (as is the bulk of most curriculum today), but also the theory behind contracting phenomena.[51]

Finally, through science and the previously mentioned achievements, decision makers will be greatly assisted in their efforts to find solutions to perplexing and complicated problems. Old fashioned judgmental decision-making will be supplanted by a more scientific approach.[52] Greater certainty and predictability will be introduced into areas previously held to be uncertain or chaotic.

Responsibilities of a Science

The discussion in this article has presented the argument that the characteristics of contracting are such that the evolution of the field into a contracting science is a very real possibility. Stating, however, that a field of study "qualifies" as a science does not mean that it is a science. To achieve true science status, the attitudes, actions and beliefs of those within the field must "qualify" as well. Additionally, science is characterized by patterns of activity which McAgnew and Pyke refer to as the "trademarks" of science.[53] These "trademarks," which distinguish science from other fields, include:

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[51] Williams and Arvis, "The Possibility of a Contracting Science," p. 28.

[52] Buzzell, Robert D., "Is Marketing a Science?," Harvard Business Review, Vol. 41, January-February 1963, p. 4.

[53] McAgnew, Neil and Sandra W. Pyke, The Science Game, Prentice-Hall, Inc., 1969, pp. 8-10.

1. An emphasis on the accurate reporting of what was observed by the researcher
2. The experimentation and manipulation of data, events, and so on in order to obtain a better understanding of cause and effect relationships
3. Expansion of the scope of scientific information to include information that is of a lasting, generalized, wider applicability nature
4. The utilization of elaborate methods to minimize the number of errors that may creep into scientific research
5. The use of more detailed and objective language in any and all communications

Underlying these science trademarks is the concept of responsibility as applied to the theoretician and the practitioner. Responsibility, in this context, means the correct identification of contracting problems, concepts and phenomena; the accurate examination and study of these phenomena; and the proper reporting and publication of research results. This responsibility includes a commitment to the asking of "why" questions. Dixon states that scientific inquiry is the ". . . continual momentum towards self-correction which propels scientific interpretation of the world more closely towards the trustworthy and reliable--towards the truth."[54] Inquiry is needed and is essential, but beyond this, the entire community has the responsibility to constantly review, criticize and accept/reject scientific research results. Science is ". . . the activity of an international community of research workers who constantly cross-check their work and criticize each other."[55] This constant evaluation and criticism is essential, for it provides the means of validating existing ideas and concepts as well as subjecting new ideas and concepts to a rigorous standard of introduction. It serves, for individuals within the field, as the vehicle for obtaining general consensus and agreement so necessary to the advancement of knowledge. The authority of science is, in fact, derived from this social responsibility of critical review and evaluation.[56]

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[54] Dixon, Bernard, What Is Science For? Harper and Row, 1973, p. 35.

The concept of science is also a mindset, one that requires rigorous analysis and testing of hypotheses, diligent search for causal relationships, and constant evaluation of theories as explanations of phenomena. Professionals within the science are responsible for the quality of the work of others just as much as they are responsible for their own work and actions. Science implies that individuals will do those things that are the trademark of science. By adhering to the concepts and meaning of science, the achievements noted earlier in this article might be obtained. Science, therefore, is more than an honorific title; it is a way of life.

Contracting Research

The increased importance and significance of contracting has demanded emphasis on the conduct of contracting research. Such research is needed to provide insight and understanding into the many intricacies, relationships and complexities of contracting. Contracting research, as currently conducted, is flawed in many respects. Difficulties exist in understanding the nature of contracting research, in the valid identification of contracting problems, in the proper evaluation of research results, in the integration of research efforts into a systematic body of knowledge, in the maintenance of research objectivity, and in the establishment of a coherent research data base. These problems hamper the effectiveness and reliability of contracting research. It is entirely feasible that by approaching contracting from a science perspective, many of these difficulties could be reduced or eliminated.

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[55] Ibid.

[56] Friedlander, Michael W., The Conduct of Science, Prentice-Hall, Inc., 1972, p. 33.

Conclusion

In examining the issue of contracting as a science, the authors offer the following:

1. The field of contracting encompasses a distinct subject matter - the acquiring of goods and services in the marketplace through the utilization of a contractual instrument -which permits focused investigation and examination.

2. The subject matter of contracting can be organized, classified and described. A proposed taxonomy, based on the contracting process, has already been introduced into the literature. Other classification schemes, to a lesser developed degree, can also be discerned and should be refined.

3. The scientific method has been and can continue to be used in the conduct of contracting research. This method concerning speculative thinking, deductive reasoning and empirical observation has relevance to the study of contracting phenomena.

4. General principles of contracting exist and can be identified. Individuals within the contracting field are aware of and familiar with concepts that can be classified as fundamental truths which are of significance and importance to the contracting profession.

5. Underlying uniformities and regularities concerning the subject matter of contracting can be identified and articulated by individuals within the field. These uniformities and regularities form the basis for empirical generalities which lead ultimately to laws and principles.

6. Contracting is evolving into a science. This article has demonstrated significant steps in the direction of science, however, a sense of responsibility for protecting the credibility of the contracting discipline must be shared by the professional people within the community. A responsibility for questioning contracting unknowns, for rigorously analyzing and testing ideas, and for scrupulously reviewing all research work is needed both to advance the knowledge of the field and to safeguard the reputation of the field.

7. Research effort should be devoted to the development of contracting theories. Theories are developed to explain and

predict phenomena, not just describe the phenomena. Too often, contracting research is focused on the "how" of a particular problem and not the "why." Cause and effect relationships need to be carefully examined and theories explaining these relationships need to be proposed. The offering of possible theories of contracting phenomena will significantly advance the knowledge of the contracting discipline. Rigorous, empirical testing is required, but the development of theories is a crucial beginning of the testing process.

3. Contracting *research* needs to be *published* and *shared* with the contracting community. The full dissemination of contracting research permits the close scrutiny and examination that is needed for the validation of research results. Intellectual discussion of new ideas and approaches is necessary for verifying the content of the research and for achieving the universal agreement so necessary for a science.

The increased importance and significance of contracting has placed greater visibility and emphasis on the field, which in turn has generated greater interest and concern over the quality of performance in the field. Individuals are becoming more interested in uncovering the answers to tough questions. Likewise, they are also concerned about the manner in which these answers are discovered and disseminated. As more answers are made known, more explanations accepted, and more individuals accept the responsibility for protecting the reputation of the profession, contracting will become a science.

Specifying the boundaries or limits of a contracting science is an essential first step in the evolution of a contracting science. By defining the subject matter, research efforts become more focused and concentrated. Greater insight is gained regarding specific relationships underlying the subject matter. The concept of a contracting science offered in this article, attempts to achieve these goals. Critical evaluation from contracting professionals is required to validate this concept.

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